DEPARTMENT OF HEALTH AND HUMAN SERVICES

NATIONAL INSTITUTES OF HEALTH

Fiscal Year 2006 Budget Request

Witness appearing before the
House Subcommittee on Labor-HHS-Education Appropriations

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William Beldon, Deputy Assistant Secretary, Budget

Mr. Chairman and Members of the Committee:

I am pleased to present the Fiscal Year (FY) 2006 President's budget request for the National Institute of Biomedical Imaging and Bioengineering (NIBIB). The FY 2006 budget includes $299,808,000 an increase of $1,599,000 over the FY 2005 enacted level of $298,209,000 comparable for transfers proposed in the President's request.

ADVANCES IN BRIDGING THE PHYSICAL AND LIFE SCIENCES

The National Institute of Biomedical Imaging and Bioengineering (NIBIB) brings together the research communities of biomedical imaging, bioengineering, and the physical sciences together with the life sciences community to advance human health by enabling technologies that improve the quality of life and reduce the burden of disease. The Institute's mission is to improve human health by leading the development and accelerating the application of biomedical technologies. The Institute is committed to integrating the engineering and physical sciences with the life sciences to advance basic research and medical care. Examples of our programs in this effort follow.

IMAGE-GUIDED MINIMALLY-INVASIVE THERAPIES

For most of the history of medicine, physicians relied on their senses – primarily vision, touch and sound – to diagnose illness, monitor a patient's condition, and perform invasive procedures. Recent advances in biomedical imaging have radically expanded these approaches. Imaging devices, such as Computerized Tomography, Magnetic Resonance Imaging (MRI), and ultrasound, allow physicians to see and diagnose disease that is hidden from normal view. On-line guidance during treatment or surgery, a concept referred to as image-guided interventions, will be the next step in reducing the trauma and improving the effectiveness of surgical procedures. Image-

guided interventions, coupled with minimally-invasive treatments – which require only a small incision, or, in some cases, no incision – result in less damage to critical organs, less postoperative pain, fewer surgical complications, shorter hospital stays, lower health care costs, and fewer work days lost.

The NIBIB is supporting research on the development of tools and technologies that can replace traditional invasive procedures with minimally-invasive, image-guided procedures that will serve as the new and improved standards of care. For example, NIBIB-funded investigators have developed a thin fiber-optic probe that may provide a rapid and accurate alternative to core needle biopsies for detecting breast malignancies. Other NIBIB researchers are developing a mechanical clot extraction system for treating stroke victims and those who are at risk for a stroke. The device, made with a new "shape memory polymer," is inserted in a vessel as a straight thin wire that can be advanced through an occlusion. However, once heated inside the body with a laser illuminator, the device reshapes itself into a coil that can latch onto the clot. The coil and the clot are then removed from the vessel, restoring blood flow.

Minimally-invasive, catheter-based treatments for coronary occlusions have already revolutionized therapeutic options for treating heart disease. However, X-ray techniques – the established method for cardiac imaging and image-guidance – have well-known drawbacks that limit their utilization and application. To overcome these limitations and extend current capabilities, NIBIB-funded scientists are developing a real-time interactive MRI system for cardiac imaging and for guidance of interventional procedures. This system may be particularly helpful in treating chronic

cardiovascular occlusions and in detecting and treating heart disease before symptoms arise.

The NIBIB is currently participating in two NIH-sponsored projects focusing on the development of informatics infrastructure that may also be useful in image-guided therapies. Under the Alzheimer's disease (AD) Neuroimaging initiative, a database will be established that will serve as a unique resource for the collection of standardized MR imaging data from across the country. Lessons learned from the database will be used to help researchers and clinicians develop new treatments for AD and monitor their effectiveness. The successful implementation of RIDER, the Reference Image Database to Evaluate Response to Drug Therapy in Lung Cancer, which is still in the early phase, will enable industry and academia to develop, test and compare semi-automated and automated software tools for evaluating lung cancer and associated treatments.

NANOTECHNOLOGY AND DRUG DELIVERY

The emergence of nanotechnology has opened a new era of research in the development of "smart" drug delivery systems. These systems have the potential of packaging highly potent drugs and targeting them with great specificity to diseased tissues or cells while minimizing side effects. Researchers are now designing and synthesizing nanometer-sized drug carrier vehicles with cell targeting surface structures. These carriers increase the likelihood of injected drugs accumulating in targeted tissues. For example, to target the delivery of anticancer agents to tumors, NIBIB-supported researchers have labeled nanoparticles with molecules that enhance their ability to bind to specific tumor cells. Scientists have also designed drug carriers

that can change shape in response to the acidity of the surrounding environment. These carriers shield acid-sensitive drugs during passage through the stomach, allowing payload delivery to the lining of the small intestine for release into the blood stream.

NIBIB-funded researchers are also developing novel transdermal and microchip technologies for delivering medications. Microneedle arrays – consisting of tiny needles too small to cause pain – are used to deliver drugs. Prototype medicine-carrying microchips, some no bigger than a matchstick, have been developed for implantation under the skin where they can slowly and accurately release a drug directly into the bloodstream. These and other developments in "smart drug delivery" technologies hold promise for improving patient compliance by making drug administration effortless, painless and effective with a minimum of side effects.

SENSORS FOR POINT-OF-PATIENT-CARE APPLICATIONS

Empowering clinicians to make decisions at the "point-of-patient-care" can have a significant impact on the quality of healthcare delivery, especially in rural settings. The ability to provide rapid "on-the-spot" assessment of a patient's health relies on the use of small, portable devices to analyze biological samples. Research at the nanoscale level has allowed scientists to develop point-of-care sensor technologies that combine multiple analytical functions into self-contained devices that can detect and diagnose disease. Some of these devices enable patient self-testing and contribute to the realization of personalized medicine by creating a link between the diagnosis of disease and the ability to tailor therapeutics to the individual. Nanoparticles coupled with microfluidics may further increase the sensitivity of sensor devices, allowing earlier disease detection and intervention. Technological advances make results available

within minutes, enabling clinicians to make immediate treatment decisions.

ADVANCES IN REGENERATIVE MEDICINE

Research and technology development in regenerative medicine promises to revolutionize current methods of health care treatment and significantly improve the quality of life for millions of patients. For example, NIBIB-funded researchers have created new materials that, based on their chemical structure, interact with progenitor cells of the central nervous system to stimulate nerve cell regeneration. This may also prevent the formation of scar tissue that is often linked to paralysis after spinal cord injury. This group has now successfully grown nerve cells using a bioengineered three-dimensional network of nanofibers as a scaffold for nerve regrowth. Other NIBIB-supported researchers have developed a material from the small intestines of pigs that is increasingly used by surgeons to restore damaged tissues and support the patient's own healing process. Physicians rely on the material, called small intestinal submucosa (SIS), for therapies ranging from reconstructing ligaments to treating incontinence. Today, SIS is most commonly used to help the body close hard-to-heal wounds such as second-degree burns, chronic pressure ulcers, diabetic skin ulcers, and deep skin lacerations. Industry is translating NIH findings into the development of new medical devices that are being used to treat patients.

INTERDISCIPLINARY SCIENCE AND TRAINING

Interdisciplinary science holds tremendous promise for remarkable advances in understanding, detecting, treating, and preventing disease. The NIBIB has developed several public and private collaborations designed to catalyze research at this interface. For example, the NIBIB and the Howard Hughes Medical Institute recently partnered

in a novel public-private partnership to stimulate the development of new interdisciplinary graduate training programs that integrate the physical, quantitative, and engineering sciences with the life sciences. This program will train a new generation of inter-disciplinary research scientists, equipped to meet the challenges of the 21st Century. The NIBIB also partnered with the National Science Foundation (NSF) to establish the Bioengineering and Bioinformatics Summer Institutes Program. This program will provide undergraduate students majoring in the biological sciences, computer sciences, engineering, mathematics, and physical sciences the opportunity to acquire research experience in interdisciplinary bioengineering or bioinformatics research and education.

To further promote collaborations between Federal agencies, the NIBIB and the NSF sponsored a ten agency conference on research at the interface of the life and physical sciences. The objectives of the conference were to identify opportunities, grand challenges, and issues at the interface that could result in major advances and to develop approaches for bridging these traditionally separate fields. Future plans for the near-term are to establish an Interagency Committee that would meet regularly to address workshop recommendations.

NIH ROADMAP TO ACCELERATE MEDICAL DISCOVERY

The NIBIB mission also strongly supports the NIH Roadmap, which focuses on cross-cutting, enabling tools. For example, the NIBIB plays a lead role in an initiative that will facilitate the development and synthesis of the next generation of novel probes for molecular and cellular imaging. Such probes would be applicable to many diseases and would help answer fundamental questions of disease pathophysiology.

Other Roadmap areas of immediate interest to, and supported by, the NIBIB include the development of nanomedicine technologies, robotics and high throughput screening technologies, and informatics techniques for computational biology. The NIBIB also strongly supports the theme of research teams of the future by sponsoring interdisciplinary research and interdisciplinary training.

In conclusion, the fields of biomedical imaging and bioengineering are expanding rapidly – from the detection, diagnosis, and treatment of diseases and disabilities at the organ level to investigation, analysis, detection, and treatment at the cellular and molecular levels. The establishment of NIBIB was predicated on both advances in and the promise of these exciting fields. As the Institute evolves in the coming years, it will continue to strive to achieve its mission and realize its vision of profoundly changing health care by leading the development and accelerating the application of biomedical technologies. The research mission and vision of having a profound impact on health care will guide the Institute to capitalize on emerging scientific areas where biomedical imaging and bioengineering approaches can be used to explore promising new directions. Thank you, Mr. Chairman. I would be pleased to answer any questions that the Committee may have.

Department of Health and Human Services
National Institutes of Health
National Institute of Biomedical Imaging and Bioengineering

Roderic I. Pettigrew, Ph.D., M.D.

Roderic I. Pettigrew, Ph.D., M.D., is the first Director of the National Institute of Biomedical Imaging and Bioengineering at the NIH. Prior to his appointment at the NIH, he was Professor of Radiology, Medicine (Cardiology) at Emory University and Bioengineering at the Georgia Institute of Technology and Director of the Emory Center for MR Research, Emory University School of Medicine, Atlanta, Georgia.

Dr. Pettigrew is known for his pioneering work at Emory University involving four-dimensional imaging of the heart using magnetic resonance (MRI). Dr. Pettigrew graduated cum laude from Morehouse College with a B.S. in physics, where he was a Merrill Scholar; has an M.S. in nuclear science and engineering from Rensselaer Polytechnic Institute; and a Ph.D. in applied radiation physics from the Massachusetts Institute of Technology, where he was a Whitaker Harvard-MIT Health Sciences Scholar. Subsequently, he received an M.D. from the University of Miami School of Medicine in an accelerated two-year program, did an internship and residency in internal medicine at Emory University and completed a residency in nuclear medicine at the University of California, San Diego. Dr. Pettigrew then spent a year as a clinical research scientist with Picker International, the first manufacturer of MRI equipment. In 1985, he joined Emory as a Robert Wood Johnson Foundation Fellow with an interest in non-invasive cardiac imaging.

Dr. Pettigrew's awards include membership in Phi Beta Kappa, the Bennie Award (Benjamin E. Mays) for Achievement, and being named the Most Distinguished Alumnus of the University of Miami. In 1989, when the Radiological Society of North America celebrated its 75th Diamond anniversary scientific meeting, it selected Dr. Pettigrew to give the keynote Eugene P. Pendergrass New Horizons Lecture. He also served as chairman of the Diagnostic Radiology Study Section, Center for Scientific Review, NIH.

Department of Health and Human Services
Office of the Budget

William R. Beldon

Mr. Beldon is currently serving as Deputy Assistant Secretary, Budget in the Department of Health and Human Services. He has been a Division Director in the Budget Office for sixteen years, most recently as Director of the Division of Discretionary Programs. Mr. Beldon started in federal service as an auditor in the Health, Education and Welfare Financial Management Intern program. Over the course of more than 30 years in the Budget Office, Mr. Beldon has held Program Analyst, Branch Chief and Division Director positions. Mr. Beldon received a Bachelor's Degree in History and Political Science from Marshall University and attended the University of Pittsburgh where he studied Public Administration. He resides in Fort Washington, Maryland.